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Test procedures for determining physical properties of brush materials

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Test procedures for determining physical properties of brush materials

FOREWORD

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IEC 60413 has been prepared by IEC technical committee 2: Rotating machinery. It is an International Standard.

This second edition cancels and replaces the first edition published in 1972. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Title modified.
b) Addition of definitions in Clause 3.
c) Clause 5 on test specimen: Nomenclature and addition of the different types of test specimen, specification on their dimensions, tolerances and preparation.
d) Improvement of test procedures of the properties already disclosed in the previous edition (Clause 6 to Clause 11).

e) Separation of apparent density and apparent porosity (respectively Clause 6 and Clause 10).

f) Resistivity (Clause 7): Addition of the eddy current method.

g) Rebound hardness (Clause 9): Addition of a new model of scleroscope and addition of Leeb method, as a possible alternative to the traditional scleroscope method.

h) Common elements of the test report in a dedicated Clause 12.

i) Addition of Annex A (normative): introduction of tests categories (serial/type tests), list of properties to be tested for each test category of test according to their purpose.

j) Addition of Annex B: test procedures for other mechanical properties than flexural strength and hardness: tensile, compressive and impact strength.

k) Addition of Annex C: test procedures for thermal properties (coefficient of linear expansion, specific heat capacity and thermal conductivity).

l) Addition of Annex D: supplement to density and porosity.

m) Addition of Annex E: recommendations on methods for elements analysis.

n) Addition of Annex F: supplement of information concerning scleroscope hardness.

The text of this International Standard is based on the following documents:

Draft	Report on voting
2/2286/FDIS	2/2298/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

1 Scope

This document concerns graphite-based grades that are used for sliding electrical contacts, such as carbon brushes or pantograph strips.

By extension, it is possible to apply the test procedures of this document to all electrical sliding contacts for electrical transmission appliances and to other appliances of graphite-based materials (heat exchangers, bearings, etc.).

This document specifies uniformized procedures for determining their following properties:

– density and porosity;
– resistivity;
– flexural strength;
– hardness;
– ash content.

In addition, it provides recommendations on test procedures for other properties:

– Mechanical properties: Charpy impact test, compressive strength, tensile strength (Annex B).
– Thermal properties: coefficient of thermal expansion, specific heat capacity, thermal conductivity (Annex C).

The properties determined by these tests are inherent to the graphite-based materials and it is therefore important to distinguish them from performance characteristics in operation on electrical equipment (carbon brush in an electrical rotating machine, contact strips on a pantograph, etc.).

Since these materials are generally brittle, porous materials, it is reasonable that their properties vary much more than the same properties in metals.

Some test methods are suitable for use in production quality control (routine tests), others only for more thorough investigations, using precise laboratory techniques (see Annex A).

WARNING — The use of this document can involve hazardous substances, operations and equipment. It does not purport to address all of the safety or environmental problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60276, *Carbon brushes, brush holders, commutators and slip-rings - Definitions and nomenclature*

ISO 148-1, *Metallic materials - Charpy pendulum impact test - Part 1: Test method*

ISO 179-1:2023, *Plastics - Determination of Charpy impact properties - Part 1: Non-instrumented impact test*

ISO 6508-2, *Metallic materials - Rockwell hardness test - Part 2: Verification and calibration of testing machines and indenters*